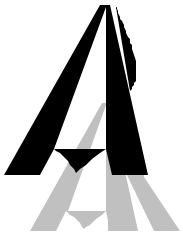

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Environmental and regional problems of contaminated sites

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Environmental and regional problems of contaminated sites

1. Economic problems of civil and public liability for contaminated sites

The initiators of environmental pollution have to pay for the avoidance of pollution or the restoration (clean up and decontamination) of the damaged areas. The initiator is called intruder by way of acting (Handlungsstörer), he initiates or causes danger for the public security and order. His retroactive liability is limited to 30 years. Many past cumulative damages are not covered by the retroactive liability, because the polluting activities took place beyond this period. On the other hand in any case it is always difficult to proof the individual causation of contaminated sites (Karl 1993), when many polluters create the damage and the contamination cannot be traced to a unique accident (Karl 1987; Franzius 1994). Due to this the initiator is not liable by civil law. If the contaminated site bears a risk on public security (damage to the groundwater, public health) not only the party who caused the damage is liable, but also the actual owner of the site.

In many cases the public liability has negative side effects and does not collect sufficient financial resources for restoration. Under these circumstances compensation mechanisms start to work. Several models are described in the following sections. In all these systems, the financing is transferred to groups with a supposed connection to the pollution. These groups should have more or less a link to the former polluter. They should have closer relationships to the purpose of the finances than the community and other parties have. Due to the specific economic structures a lot of different models of financing have been developed in several Bundesländer. In these models the problem often occurs that non-polluting firms have to pay for pollution while enterprises which polluted in the past do not have to pay proportionally to their contribution to the damage. Finally some aspects of centralisation and decentralisation of steps to finance the redevelopment of contaminated sites are mentioned.

2. Costs of redevelopment

The following remarks and tables are to meant to show the reader the problems of the quantitative investigation of the costs for the redevelopment of inherited liabilities. These problems do not merely arise in determining the future costs, but also in quantifying the costs of the past redevelopment. The research project KOSAL (Systematik zur frühzeitigen Ermittlung der Kosten bei der Altlastensanierung) developed a method to determine the costs of redevelopment and made it possible to create a new subdivision for the elements which

build the cost components in case of redevelopment. The new subdivision divides the costs for different part performances (services).

The following table shows the possible shares of the costs for the different services, but unfortunately, no statements about the total costs of special cases are possible:

Part performances (part services)	Share of total cost (%)				
	Securing		Decontamination		
			Off-site		On-site
	Insulation of surfaces	Vertical insulation	Thermal technique	Chemical-physical technique	Micro-biology
Purchased services	4 - 10	4 - 10	5 - 10	5 - 10	5 - 10
Logging	0.5	0.5	0.5	0.5	0.5
Estimation of danger potential	0.1 - 3	0.1 - 3	0.5 - 5	0.5 - 5	0.5 - 5
Defence of danger (immediately)	0.5 - 2	0.5 - 2	0.5 - 2	0.5 -2	0.5 - 2
Investigation for redevelopment	3 - 6	3 - 6	3 - 8	3 - 8	3 - 8
Basic subjects (Kernleistungen)	60 - 70	45 - 65	32 - 50	30 - 50	50 - 60
Accompanying services	15 - 30	25 - 45	37 - 57	27 - 47	30 - 35
Planning	5 - 9	5 - 10	5 - 7	3 - 6	5 - 10
Installation of building site	2 - 10	8 - 14	3 - 6	3 - 5	6 - 8
Ground moving	1	2 - 5	10 - 15	8 - 12	10 - 15
Safety measures	5	5	5 - 8	4 - 7	5 - 8
Water control	-	0 - 20	0 - 3	0 - 3	0 - 3
Transport	-	-	5 - 30	5 - 25	-
Storage	1 - 4	4 - 10	0 - 15	0 - 12	-
Pre-treatment (e.g. sift)	-	-	0 - 5	0 - 4	0 - 3
Check-up and control	1 - 4	1 - 4	4 - 9	4 - 8	4 - 8
Public relations work	0.1 - 0.5	0.1 - 0.5	0.1 - 0.5	0.1 - 0.5	0.1 - 0.5
Compensations	variable				
Post restoration consequences	6 - 10	6 - 10	6 - 10	18 - 30	5 - 12
Waste product utilisation	-	1 - 3	1 - 5	14 - 22	1 - 8
Re-assembling in nature	1 - 3	-	5 - 8	5 - 8	4 - 8
After-care/supervision	5 - 7	5 - 9	-	-	-

(see: Bracke et al., 1992)

The expected costs for the estimation of the danger potential depend on the size of the area, too, but there are vast differences in the amounts for the special cases.

Costs for the estimation of danger potential			
Old locations		**Old waste disposal sites**	
Operation area (m^2)	Costs (DM/m^2)	Deposit area (m^2)	Costs (DM/m^2)
< 5.000	> 15	< 5,000	5 - max. 20
5.000 - 10.000	10 - 15	5,000 - 50,000	1.50 - 5
10.000 - 25.000	5 - 10	> 50,000 - 200,000	0.50 - 1.50
25.000 - 100.000	1.50 - 5	> 200,000	0.30 - 0.50
> 100.000	0.80 - 1.50		

The cost margin for different proceeds of decontamination is very wide, because the factors influencing the costs are strictly unlike. So, the estimations of the costs should not be generalised. The following list provides a summary of the figures by different proceeds.

Proceed of decontamination	Costs
Thermal techniques (Thermische Verfahren)	150 - 500 DM/t
Techniques of washing and extraction (Wasch- und Extraktionsverfahren)	200 - 600 DM/t
Micro-biological techniques (Mikrobiologische Verfahren)	150 - 360 DM/t
Electrokinetic techniques (Elektrokinetische Verfahren): Encapsulation (Einkapselung) Insulation of surfaces (Oberflächenabdichtung) Sealing-wall (Dichtwand) Additional sealing of the basis (Nachträgliche Basisabdichtung)	100 - 350 DM/t 100 - 300 DM/m^2 30 - 600 DM/m^2 400 - 2,500 DM/ m^2

The variety of cost factors for the thermal techniques gives an example for the multiple influence on the costs:

- Characteristics of the contaminated ground (e.g. moisture content)
- Parameters of the machinery and equipment for the decontamination (e.g. type of the system, staff required)
- Energy-management (e.g. level of temperature)
- Permissions and legal influences (e.g. subjects to approval)
- Reduction and elimination of pollutants (e.g. kind and numbers of stages for the cleaning)

Besides the different proceeds and their cost factors, the aim of the decontamination is important and causes targeted measures. As an example for different levels of aims, the objectives of the Bundesland Rhineland-Palatinate is mentioned here (source: ALEX-Merkblatt-02):

- Objective 1: The restoration of a state which prevents harmful effects on the environment is the aim of objective 1. The state of the environment should not affect the ecosystem. This means that materials, which do not naturally exist in the environment, have to be eliminated. The loads have to be reduced to the natural regional level. (Nearly natural/without disturbance of function/multi-functional utilisation)

- Objective 2: The restoration of a state that allows the usual utilisation of the environment by humans and that initiates neither eco-toxical effects nor serious effects on the environment is the aim of objective 2 (sensible utilisation/no dangers for humans; e.g. residential areas). The utilisation mostly are subdivided in (SRU, 1995, p. 58):
    - playgrounds
    - residential areas
    - sports fields
    - parks
    - industrial and business areas
    - agricultural acreage
    - used areas which are not agricultural acreage (e.g. forests)

- water protection areas
- nature reserves

- Objective 3: The restoration of a state that guarantees that the human health will not be endangered, if necessary within the reduction of the possibilities of utilisation (no dangers for humans, reductions of utilisation possibilities; e.g. industrial area).

Jessberger (1993) estimated the costs for the redevelopment of inherited environmental liabilities in Germany in the following manner (Data-basis of the suspected polluted areas is the estimation of the Federal Ministry of the Environment (1992): 89,000 suspected polluted areas in the Old- and 49,000 in the New Länder):
He subdivided the areas of inherited environmental liabilities in 3 groups (by size) and supposed that 10% of these areas in West-Germany and 30% in the New Länder are really inherited environmental liabilities.

Group	1	2	3
Share	80%	18%	2%
Volume (m^3)	40,000	200,000	1,000,000
Size of the area (m^2)	2,000	10,000	50,000
Radius	25	56	126
Quantity	18,900	4,250	450

Moreover, he distinguished 3 levels (cases) of redevelopment for all contaminated sites and calculated estimations between 184,000 million DM and 925,000 million DM of costs for the redevelopment:

Group	1	2	3	Total
Case 1	100% decontamination (450 DM/m^3)			
	340,000 Mio. DM	383,000 Mio. DM	202,000 Mio. DM	925,000 Mio. DM
Case 2	20% special decontamination (750 DM/m^3) 80% securing steps			
Decontamination	113,000 Mio. DM	128,000 Mio. DM	68,000 Mio. DM	
Securing	11,000 Mio. DM	11,000 Mio. DM	4,000 Mio. DM	
Total	124,000 Mio. DM	139,000 Mio. DM	72,000 Mio. DM	335,000 Mio. DM
Case 3	10% special decontamination (750 DM/m^3) 90% securing steps			
Decontamination	57,000 Mio. DM	64,000 Mio. DM	34,000 Mio. DM	
Securing	12,000 Mio. DM	12,000 Mio. DM	5,000 Mio. DM	
Total	69,000 Mio. DM	76,000 Mio. DM	39,000 Mio. DM	184,000 Mio. DM

If we use the above-mentioned procedure of case 1 for the 258 decontaminations carried out in Northrhine-Westphalia (NRW), we get the following results as an estimation for the expenditures in the past (31.12.1994):

Group	1	2	3	Total
Share	80%	18%	2%	
	100% decontamination (450 DM/m^3)			
Quantity	206	47	5	258
Volume (m^3)	40,000	200,000	1,000,000	
Costs	3,710 Mio. DM	4,230 Mio. DM	2,250 Mio. DM	**10,190 Mio. DM**

3. Regional financing models practised in Germany

3.1. The Old Länder

Two financing mechanisms are practised: On one hand the industry and the Länder co-operate and the financing of the restoration is the result of the bargaining process between the co-operating partners (for example in Bavaria and Rhineland-Palatinate). Other models operate with an additional charge on the industrial hazardous waste or other tax mechanism. The charge increases the production costs.
The following presentation provides an overview and is based on two reports of the German Council of Environmental Advisers (Rat von Sachverständigen für Umweltfragen, SRU).

1) In Northrhine-Westphalia e.g. until 1993 approximately 2,000 measures have been supported with about 308 million DM. In principle financing of the redevelopment of contaminated sites is based on budgetary means of the Bundesland and on the so called licence-model. In this model, licences are required for obtaining the permission for hazardous waste treatment. Someone who wants to be employed with special waste deposits has to pay for the licence at the `Landesamt für Wasser und Abfall` (county state department of water and waste). This charge is mainly used for the financing of restoration steps (at least 70 per cent). The revenue from the licences shall reach the sum of 50 million DM. In NRW a public-law corporation (Abfallentsorgungs- und Altlastensanierungsverband Nordrhein-Westfalen, AAV) is responsible for the restoration. This corporation gets its necessary takings from the Land which in turn receives the money from the payments for the licences.

2) Often the restoration is based on the co-operation between enterprises and regional administrative bodies. They become partners with equal rights by agreements which are legally non-obligatory. The procedure usually starts by the establishment of a private-law corporation for restoration. In the following sections, these models are briefly described (see SRU 1995, pp. 75ff.):

- In the Bundesland Rhineland-Palatinate, the inherited environmental problems are primarily determined by a small number of chemical companies. In 1986 the federal state government, the regional administration bodies and the industry concluded an agreement of co-operation. This agreement included the regulation of restoration. A special private-law corporation (called Gesellschaft zur Beseitigung von Sonderabfällen (GBS)) was made responsible for the implementation of the restoration steps. The company members of the GBS were representatives of the co-operating partners. The financing parts of the regional administration bodies are based on the 'polluter pays principle' as much as possible, one can say that this system is a kind of 'polluter pays principle in a wider sense'. The remaining costs were been paid at par by the Land and the GBS. This adjustment was only used in cases when polluters were able to pay parts of the costs. The agreement did not include cases where no initiator of pollution could be made liable. Within four years, a financing-size of 50 million DM was reached, in which the industry procured its share of 6.25 million DM by an extra charge on the taxes on special waste. It must be appreciated that the group which had to take the burden of costs had got an obvious connection to the pollution. Additionally, there are incentives to avoid special waste. But the implementation of the co-operation was not extended. The industry cancelled the agreement (1993) because the federal state government intended to include cases where no initiator of pollution could be made liable (see SRU 1995, p. 90). It is not possible to transfer this model to the other Länder, because the conditions for co-operation are particularly convenient in Rhineland-Palatinate. The number of enterprises who have to take part in the negotiations is relatively small. In 1993 the `Sonderabfall-management GmbH Rheinland-Pfalz` (SAM) was founded as a coordinative instance for hazardous wastes. This enterprise has got an option to adopt the complex of redevelopment of inherited liabilities but there is no financing model existing so far (see Bettmann 1995, pp. 9f.).
- A similar model was practised in the Bundesland Bavaria, but here the municipal facilities do not take part in the co-operation. An agreement between the industry and the federal state government creates a private-law corporation (Gesellschaft zur Altlastensanierung in Bayern, GAB, 01.01.1989) and a finance model for the next 10 years. The financial participation of the firms depends on a contribution rate which is connected with the costs for the hazardous waste disposal of the enterprises. The yearly share of each enterprise is 10% of the due for hazardous waste, but in maximum 300,000 DM or 1/25,000 of the returns of the Bavarian machinery and equipment, but

in maximum 50,000 DM. The minimum contribution is 500 DM/p.a. (see Bettmann 1995, p. 6). The financial volume for the Land and the industry is 3 million DM per year for each party. Thus, the fund at disposal for the measures of restoration in Bavaria is 60 million DM.

3) The system of the Bundesland Hesse is similar to the Bavarian concept. In 1989 the duties according to the inherited liabilities have been transferred to the corporation `Hessische Industriemüll GmbH` (HIM) as a co-operation-project between the Land and the enterprises with a financial volume of 50 million DM for the first three years. The shares in contribution were divided at par for the Land and the enterprises. The industrial part was financed by an additional charge on the disposal of hazardous wastes. In addition to this, a fund for municipally caused inherited liabilities was established, paid at par by the Land and the municipals. This fund also had a volume of 50 million DM for the first three years. The financial resources were raised by a contribution to finance inherited liabilities which had to be paid by the producers of wastes. Later, the co-operation agreement in Hesse was given up, and the federal state government established a special tax on hazardous wastes, partly used to finance the restoration of inherited liabilities. 10 - 12 million DM of the tax revenue per year are used to finance restoration measures. The main part to finance the restorations in Hesse now is realised by financial resources of the state government (about 55 million per year).

4) In the Bundesland Lower Saxony the `Niedersächsische Gesellschaft zur Endlagerung von Sonderabfall mbH` (NGS) had been established to co-ordinate the redevelopment. The state government has introduced taxes on hazardous wastes. The tax revenue is predominantly used to avoid contaminated sites so that the redevelopment has to be financed by financial resources of the Land. It had been planned to found the `Gesellschaft zur Finanzierung der Altlastenbehandlung in Niedersachsen mbH` (GFA) to finance the restoration of contaminated sites. The business shares should be divided in relation 2:1 for the Land and the industry which should be represented by the association `Verein der niedersächsischen Wirtschaft zur Finanzierung der Altlastenbehandlung e.V.` (VFA). A financial volume of 9 million DM p.a. had been planned. The share of the industry should be financed by membership dues at the VFA. The membership of the enterprises in this association should be voluntary. This

would have lead to the consequential effects that neither incentives for prevention would have been given nor a relation to the initiatorship would have been established. Besides, the total sum of 9 million DM appears too insignificant.

A summary of the used financing models in the Old-Länder is shown in the following table:

Model	Bundesland
Duties	Bremen; Berlin; Lower-Saxony; Baden-Württemberg; Hesse (since 1991); Schleswig-Holstein
Licence model	Northrhine-Westphalia
Co-operation model	Bavaria; Rhineland-Palatinate (up to 31.12.93); Hesse (up to 1991)
Without model	Hamburg; Rhineland-Palatinate (since 01.01.94); Saarland

3.2. The New Länder

The German environmental law is in force in the New Länder since the German reunion, but these Länder have got a special position by an 'exemption clause' (Freistellungsklausel) which was granted and fixed in the `Umweltrahmengesetz` of the old DDR, in the `Einigungsvertrag` and the `Hemmnisbeseitigungsgesetz' (Gesetz zur Beseitigung von Hemmnissen bei der Privatisierung von Unternehmen und zur Förderung von Investitionen from the 22.03.1991). This exemption clause includes the possibility for the purchaser of plants to get rid of the damages caused before 01.07.1990. If the application for this was made before 28.03.1992, the responsible authority could approve the exemption from public-law claims. The authority had to decide in special cases and had to consider the interests of the purchasers, the general public and environmental protection. This application could have been confined to special pollution or special plants. The 'exemption clause' did not prove to be successful in practice because the area of application and the instructions for use had been restricted too much. The acceleration of investments was not possible. After liberalising some restrictions in the 'Hemmnisbeseitigungsgesetz' first successes can be noticed.

On the 22.10.1992 the Federal government and the governments of the Länder agreed to a system of financing contaminated sites in the New Länder. The Treuhandanstalt (THA) and the Länder divided up the costs of that exemption clause in proportions of 60 (THA) to 40 per cent (large projects: 75 to 25). The financing has been limited to 1000 million DM for the first 10 years. After the disintegration of the THA the debts of this authority were distributed and the Bundesländer had to take over parts of this debts. Its debts in the framework of the restoration of contaminted sites have not been distributed on the Länder for not burdening them a second time for the same problem (see Kühl 1994, pp. 155ff.). This settlement has been introduced because the initiators of environmental damages could not be found out to take the responsibility and finally the government - as the owner of the productive equipment and capital goods - was blamed for the pollution. Purchasers and owners of plants and plots of land are promoted economically by the protection against the legal utilisation and the financing by the community. Between 1990 and 1991 41 million DM for 91 projects had been granted for the new Länder by the Ministry for Environmental Affairs (see BMU 1994) and between 1991 and 1992 144 million DM had been spent. This agreement has been changed in December 1994 to expedite the operating processes. Now the New Länder can carry out independently all the redevelopment-projects which have an expenditure less than 1,5 million DM. Additionally a fund for cases of hardship (size: 2 million DM) has been established for the acquirers of Treuhand-enterprises who agreed to take the cost of redevelopment but where the increasing trend of cost was not foreseeable (see Bettmann 1995, pp. 3f.).

Moreover, in the New Länder Thüringen, Brandenburg and Berlin two organisations for the financing of restoration have been founded. For Brandenburg and Berlin the `Sonderabfallgesellschaft Brandenburg/Berlin mbH` (SBB) was established in Nov. 1994 to organise the disposal of problematic waste. Referring to inherited environmental liabilities it has got only the function of an organiser, not of a promoting company.
In Thüringen the `Thüringer Sonderabfallgesellschaft mbH` (TSA) was founded in 1993 as a promoting company to redevelop inherited liabilities and to organise the disposal of problematic waste. The financial basis is the agreement of Federal Government and the Länder of 1992 and 1994 (see Bettmann 1995, pp. 6ff.).

Overview: Inherited environmental liabilities; financing and organisation (see: Bettmann 1995, pp. 5 and 19):

State	Company	Founded	Tax on waste (yes/no), predicted income/year (in million DM)	Budgetary means of the Bundesland (in million DM)
Baden-Württemberg	---	---	yes 30 - 40, only a small part for contaminated sites	85 - 100
Bavaria	Gesellschaft zur Altlastensanierung in Bayern mbH (GAB)	1989	no	
Berlin	Sonderabfallgesellschaft Brandenburg/Berlin mbH (SBB)	1994	no	80 - 100 (AFL)[1]
Brandenburg	Sonderabfallgesellschaft Brandenburg/Berlin mbH (SBB)	1994	no	45 - 50
Bremen Hamburg	--- ---	--- ---	yes 8 - 10 no	 50
Hesse	Gesellschaft Hessische Industriemüll GmbH (HIM)	1989[2]	yes 50, only 10 - 12 for contaminated sites	50 - 60
Mecklenburg-Vorpommern	---	---	no	(AFL)
Lower-Saxony	Niedersächsische Gesellschaft zur Endlagerung von Sonderabfall mbH (NGS)	1985	yes 50	
Northrhine-Westphalia	Abfallentsorgungs- und Altlastensanierungsverband Nordrhein-Westfalen (AAV)	1988	licence 50, at least 50% for contaminated sites	30 - 40
Rhineland-Palatinate	Gesellschaft zur Beseitigung von Sonderabfällen in Rheinland-Pfalz mbH (GBS) Sonderabfallmanagement GmbH Rheinland-Pfalz (SAM)	1978 1993	no	
Saarland	---	---	no	0,1
Sachsen	---	---	no	(AFL)

[1] AFL: According to the Agreement between the Federal government and the Länder governments.

[2] Section redevelopment of contaminated sites.

Sachsen-Anhalt	---	---	no	(AFL)
Schleswig-Holstein	---	---	yes 50	---
Thüringen	Thüringer Sonderabfallgesellschaft mbH (TSA)	1993	no	(AFL)

4. Regional and environmental economic aspects of financing

4.1. Regional allocation of responsibilities

In addition to the choice of environmental policy instrument, a regulatory authority must be selected. The normative economic theory of environmenal regulation approves the principles of fiscal and territorial equivalence (Cropper, Oates 1992; Oates, Schwab, 1988; Tiebout, 1956; Tullock, 1969; Buchanan, 1965). Due to this contaminted sites there are primarily local and regional problems. The local and regional communities are suffering public bads caused by contaminated sites and they get the benefits of restoration. In contrast to central solutions decentralised restoration policy makes it easier to

- install the `polluter pays principle`,
- identify local and regional preferences for restoration in accordance to following use of the restorated sites,
- reflect different restoration costs among the jurisdictions,
- test different methods of technical restoration, and
- make a wide range of experiences with different instruments of environmental policy.

They are more flexible to handle and can be individually adjusted on the special conditions in each region. On the other hand central solutions are inappropriate, because they reduce the opportunities of local and regional communities to realise restoration levels which depend on their willingness to pay and they need considerable administrative efforts. The main advantage of central regulatory authorities is its ability to collect sufficient financial resources. In general the `Old Länder` are able to finance the restoration costs and therefore is no need for central financial activities. But if local and regional jurisdictions like the `New Länder` are not able to finance restoration costs transfer payments (Finanzausgleichszahlungen) are necessary and they should be collected from central authorities (Musgrave 1978, p. 146). Irrespective of the central financing the implementation of local and regional restoration programms should be organised decentrally.

4.2. Financing instruments

Discussing financing systems for compensation and restoration of damages we have to reflect the interest in:

- fairness,
- financing mechanism which are efficient in a way that they prevent future contamination,
- sufficient financial resources for restoration.

In general target conflicts between these interests exist. Fairness means that the polluter which caused the damage has to pay for the restoration. On the background of different reasons (unclear causation etc.) the restoration of contaminated sites are also financed by parties which are not individual or civil liable. This causes conflicts with fairness principles and a better alternative might be the financing of restoration costs by the local and regional jurisdiction. The major disadvantage of such a solution is low efficiency incentives to prevent future soil contaminations. Taxes on objectives which are responsible for site contaminations, for example emissions, specific inputs etc. create incentives to prevent future contamination. These instruments are efficient, but if the industry decreases the use of charged inputs the tax volume for compensation might be too low. Therefore, additional financial resources by the local and region government are necessary.

In contrast to the US-Superfund the German Länder have not established charges on products and liability insurances:

- Under competition the output charge initiates an increase of the product prices and a decrease of the production. Who bears the financial burden depends on the price elasticity of the demand and supply. Is the demand price elasticity high (low) and the supply price elasticity low (high) the main fraction of the tax are born by the producer (consumer) (see Probst et al. pp. 80f.). The effect of product charges depends on the opportunities of the firms to increase the product prices. If the market demand on the product market pays the bill and if the product prices increase, the demand will certainly decrease in the long run. If the firm has no substitution opportunities the effects of a product charge and an input charge are the same. If the firm has substitution opportunities the decrease of the production is lower in the case of an input tax than in the case of an output charge. If the externalities and damages depend more on specific inputs than on the output level, input charges increase the internalisation effects, because they have specific incentives for input substitution. Both instruments (product and input charges) are not kind of optimal (in terms of prevention incentives) mechanism to allocate financial responsibilities for past pollution damages between the different parties. The main disadvantage can be seen in the

fact, that the current level of waste or the current level of production do not correspond with the individual contribution to the contamination. Additional charges on products and inputs can only be installed efficiently on the federal state level. Opportunities for decentral solutions of the contaminated site lead a reduction of these problems.

- Charges for liability insurances will increase the insurance price and the price for financial resources. On the one hand this finance systems might be sufficient to collect money for the restoration of contaminated sites. On the other hand they do not have prevention effects and the financial contribution to the fund for redevelopment does not correspond with the causation of the damage. Moreover, insurances are not the polluting products which have to be restricted. Insurance taxes - like any new tax - increase administrative and compliance costs (see Probst et al. 1995, p. 87). It is difficult to estimate the effects on the insurance premia, but empirical studies for the USA (Superfund) indicate an increase of the insurance premia (property and casualty insurance) of 0.2 to 0.4 percent (see Probst et al. 1995, p. 85).

In partial accordance with the Superfund solution the German Länder work with cooperation models and input taxes (Oates 1994, p. 118). Decental solutions are able to reduce transaction costs and give the chance to use methods closely related to the `polluter pays principle`. The inclusion of the firms in such an agreement has lower transaction costs because of the small number of co-operating participants and better opportunities to control free riders. As we have seen, the co-operation model practised in Rhineland-Palatinate could not be transferred e.g. to the conditions of Northrhine-Westphalia, the implementation of such a system seems impossible due to the great number of concerned enterprises. Co-operation models are used in the Länder where the number of affected enterprises is low and a local concentration of the firms can be found. In general, co-operation is advantageous for both sides:

- The public acceptance of the industry is growing.
- The enterprises have the advantage that the federal state puts aside legislative initiatives whose realisation could be more expensive or more restrictive than the assertion of existing regulations. This procedure can avoid innovative adjustments. The firms `calculability' of the costs increases and they are involved in the co-ordination of the steps of restorations.
- The economic attractive use of sites are not longer blocked by contamination and local communities as well as regions get more opportunities for land use.

Altogether, the co-operation models with a small number of co-operating participants are said to be a flexible financial instrument to solve problems of restoration. While considering the advantages of these models, the search for the initiators of environmental damages and the use of the polluter pays principle must not be neglected, because these concepts are superior in the economic view.

As an element of co-operation modells we have identified different types of fees and taxes. The government in Northrine Westfalia pursues three aims with the licence model: First, it should have the character of a charge for use, because the licence-taker pays for the advantages of the licence. Second, it should act as an incentive for preventing environmental damages and finally, it should collect sufficient financial resources for restoration.

- The first aim cannot be achieved because of the structure of the market. The licence-taker has got incentives to pass the costs of the licences to the producers of the waste, because the structure of the market tends to be monopolistic and the elasticity of the demand is low. The waste producers do not have - in the short run - the possibilities to dispose from refuse and sewage by themselves. This market will become a field with no or low competition (see Karl 1987, p. 53).
- In this model the incentives for prevention are affecting the waste producers, because the costs of waste disposal increase as the charge will be passed to them. The waste producer wants to reduce his financial burden and compares the costs of avoidance with the costs of the waste disposal. However, in the case of NRW, this model apparently has not achieved significant incentives for avoidance (see SRU 1990, Tz. 760; Karl 1988, pp. 357ff.), so that the adjustment regulates the activities of waste disposal, but does not limit activities of emissions.
- The licence does not correspond with the expected future damages or with the contribution to the past damages. Not all present-day producers of waste have caused environmental damages in the past, but all of them have to pay for the restoration. Therefore, not prevention, but financial interest determines the licence system.

Input charges are an alternative to the licence modell. The effects of input charges depend on the product market situation if firms are able to increase prices in proportion to the input charge. Only under the unrealistic situation that the product demand does not react - neither in the short nor in the long run - the input charge would have no effect on the future environmental damages. In more realistic situations the output price increase reduces the production and the input volume. Higher prices induce a decrease of demand with the strength of this effect depending on the price elasticity of demand (e.g. substitution opportunities for the demand). Shrinking profit reduces the attraction of the sector and reduces the capital flow into the sector or leads to the failure of marginal firms (see

Probst et al., pp. 75ff.). The profit decrease induces the search for opportunities to substitute the critical inputs. The substitution process increases the prevention if the environmental risk depends on the input factor. If the critical inputs of each firm are the object of the charge the firms contribute financial resources in dependence of their contribution to the damage.

For the New Länder, financing by the `common charge principle` (Gemeinlastprinzip) is reasonable. From the allocative point of view, the `polluter pays principle` is superior to other mechanisms of financing for the redevelopment but this principle cannot be used in situations in which no initiator can be found out like in the New Länder. Burdening new owners - who did not cause the damages - would be an essential handicap for investments.

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